

577-0102

OPERATING AND INSTRUCTION MANUAL

RESOLVER SIMULATOR

MODEL 531 - S-3087

INSTR.
LAB.

NORTH ATLANTIC
industries, inc.





OPERATING AND INSTRUCTION MANUAL

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LAB.

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NORTH ATLANTIC industries, inc.

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CAUTION

High voltage exists at several points in the instrument. Normal precautions consistent with good practice should be taken to reduce shock hazard.

A potential shock hazard exists when ungrounded power source or ungrounded case operation is employed. Persons operating the instrument should be made aware of and take precautions against this condition.

North Atlantic Industries, Inc. cannot be held responsible for damage to person or property in the process of or as a result of maintenance, calibration, or setting up of the instrument.

BRUNING 40-135 32372



SECTION I

GENERAL DESCRIPTION

The Model 531 Resolver Simulator provides precision performance in a small panel mounted configuration for production test and ground support equipment applications. The trigonometrically wound toroidal transformers enable direct simulation of 11.8V line-line Resolver transmitters. (RX)

The dial reading by sealed thumbwheel switches is presented for easy reading at 45° segments.

The minimum package size and low cost meets many test system applications. Several options are available, typically 90V line-line output.



SERIES 531 RESOLVER SIMULATORS

General Specification

The following specification applies to North Atlantic's 531 Resolver Simulators. Where a special modification or variation is involved, the governing specification will either be a separate specification control document, the buyer's purchase order, or a supplement contained in this manual. Specification for special instruments are identified by the specification "S" number appearing on the instruments nameplate.

Excitation:	26 volts
Frequency:	400Hz
Output Voltage (L-L)	11.8 volts
Accuracy:	±30 seconds of arc or ±.0083°
Resolution:	Coarse dial - 45° steps, 0 to 315° Fine dial - 5° steps, 0 to 40
Input Impedance:	2K (Nom.) at 26V 400Hz unloaded
Output/Input:	All models are isolated
Size:	Approximate - Width = 3-1/2" Height = 3" Depth = 6-1/2"



SECTION II

INSTALLATION

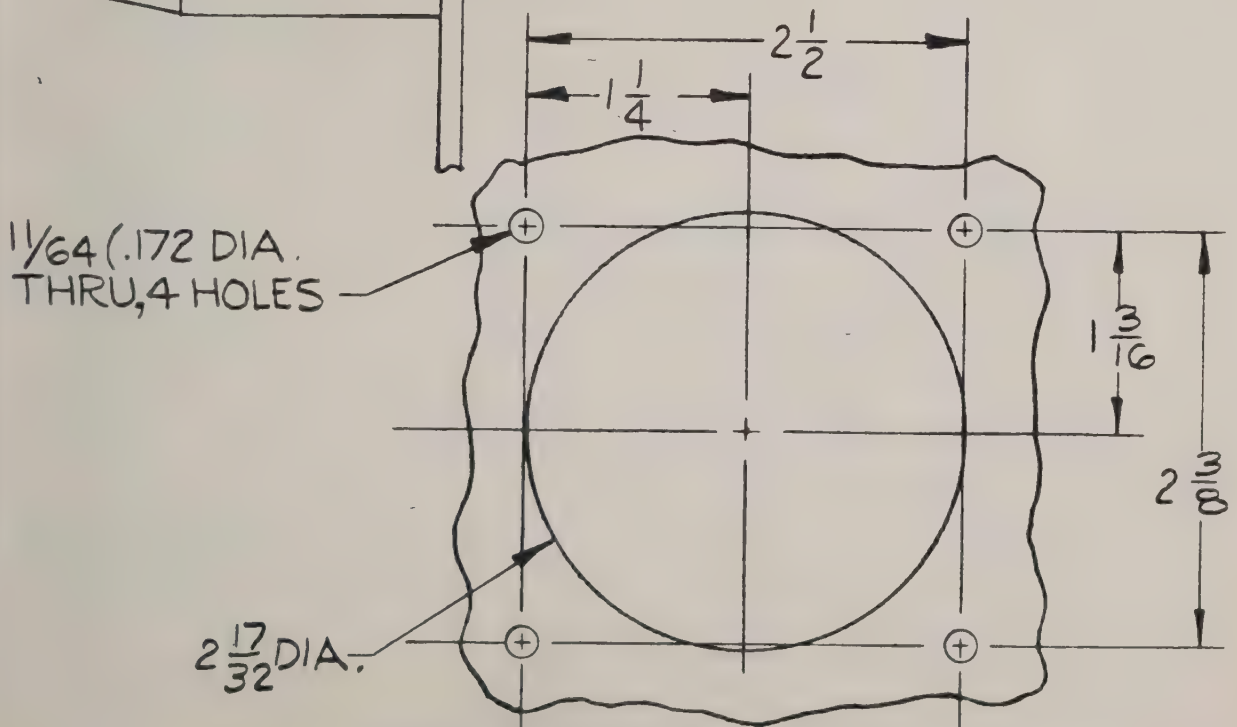
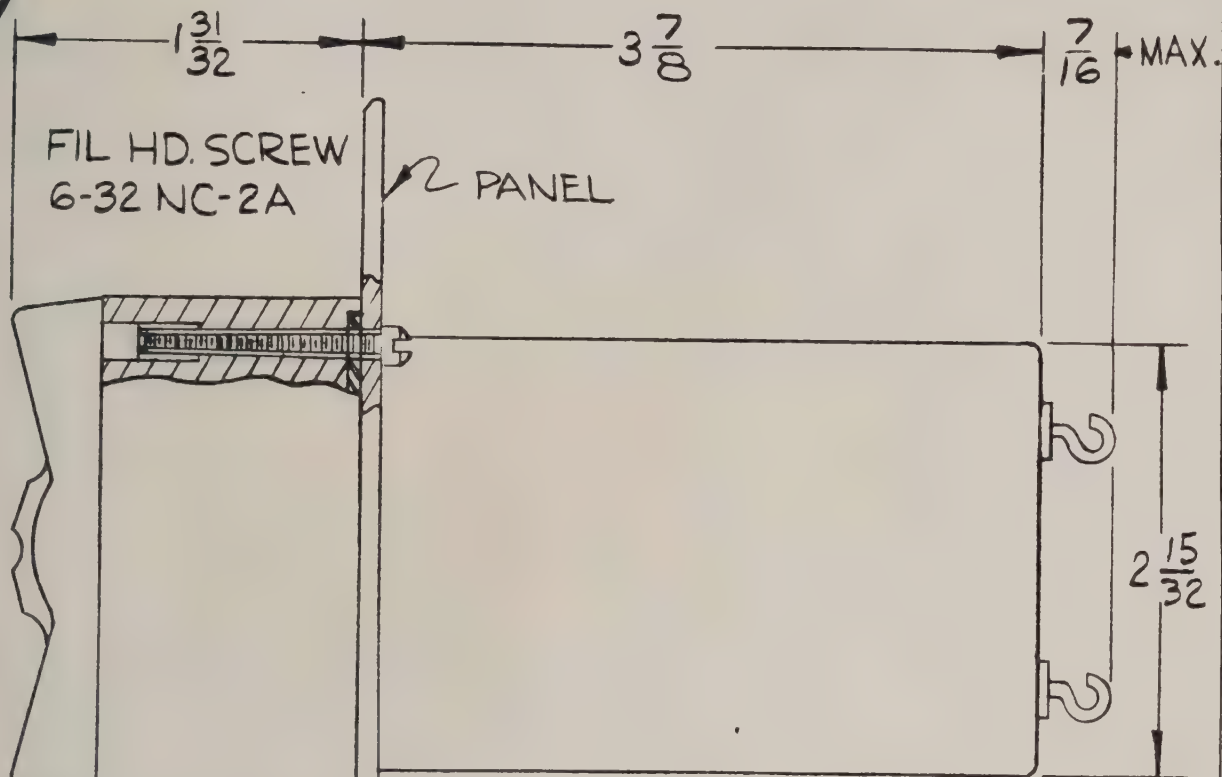
The North Atlantic Series 531 Resolver Simulator is designed for panel mounting on a hole cutout of approximately 2 1/2" in diameter.

The all passive circuits used, generate no heat and therefore, there need be no space allocated for cooling purposes.

The rear connectors are hook type stand-offs that allow direct soldering of wires.



FRONT MOUNTED

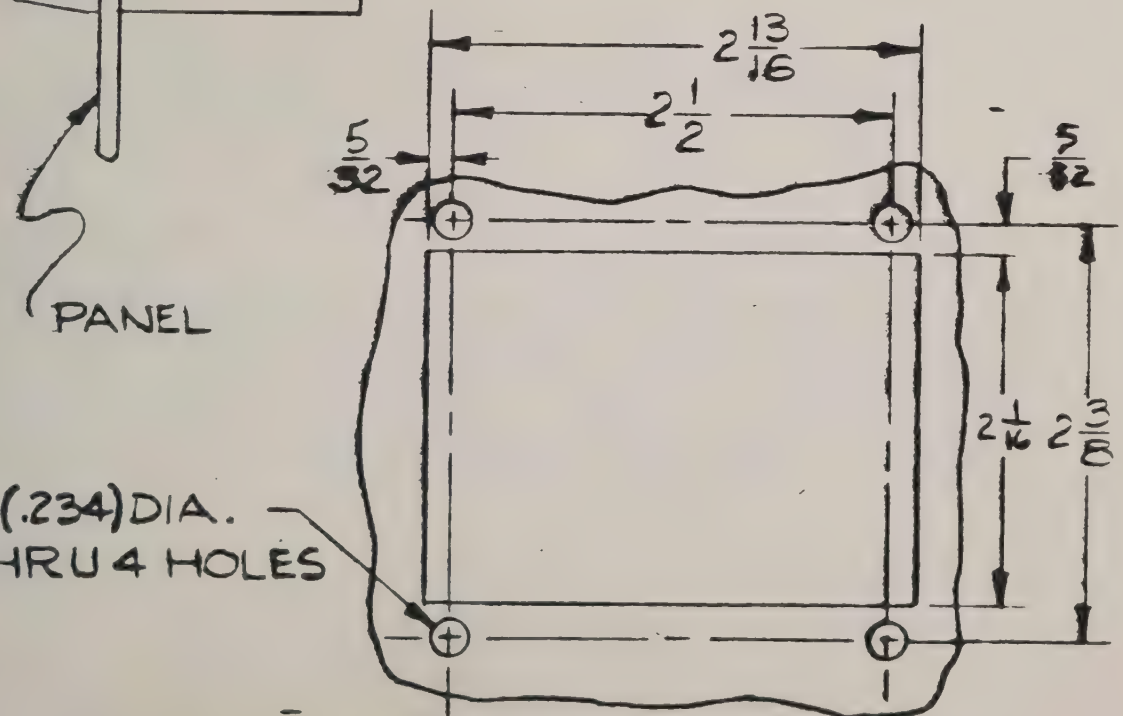
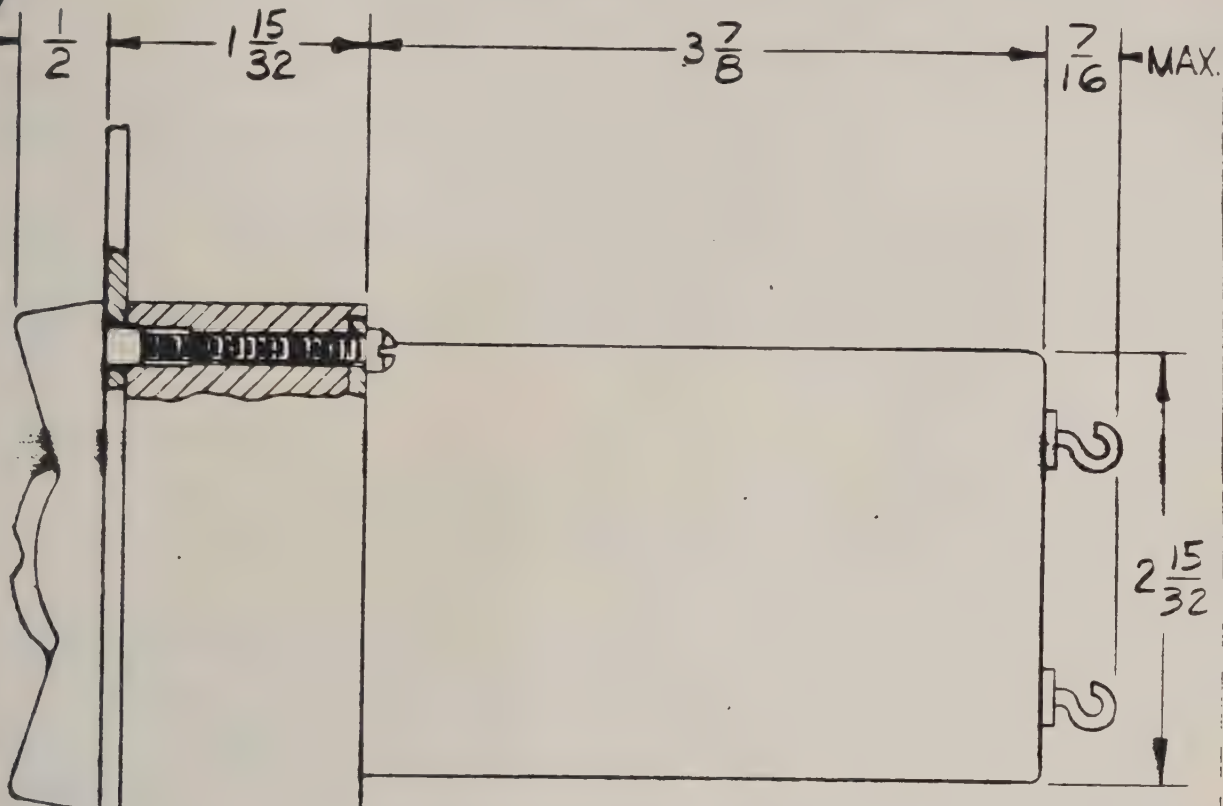


2.2

FRONT MOUNTED PANEL CUTOUT



PANEL MOUNTED



15/64 (.234) DIA.
THRU 4 HOLES

2.2 A

PANEL MOUNTED CUTOUT



SECTION III

OPERATING PROCEDURE

Excitation Terminals

Power is applied to the Simulator at the rear excitation terminals. The high side of the excitation should be applied to H1 and the ground side of the excitation should be attached to Lo. The case should be placed at ground potential by either the rack-mounting connection or a jumper from the "Lo" terminal.

Output Terminals

Output terminals are located on the rear of the unit. They are hook type terminals that accept soldered wires.

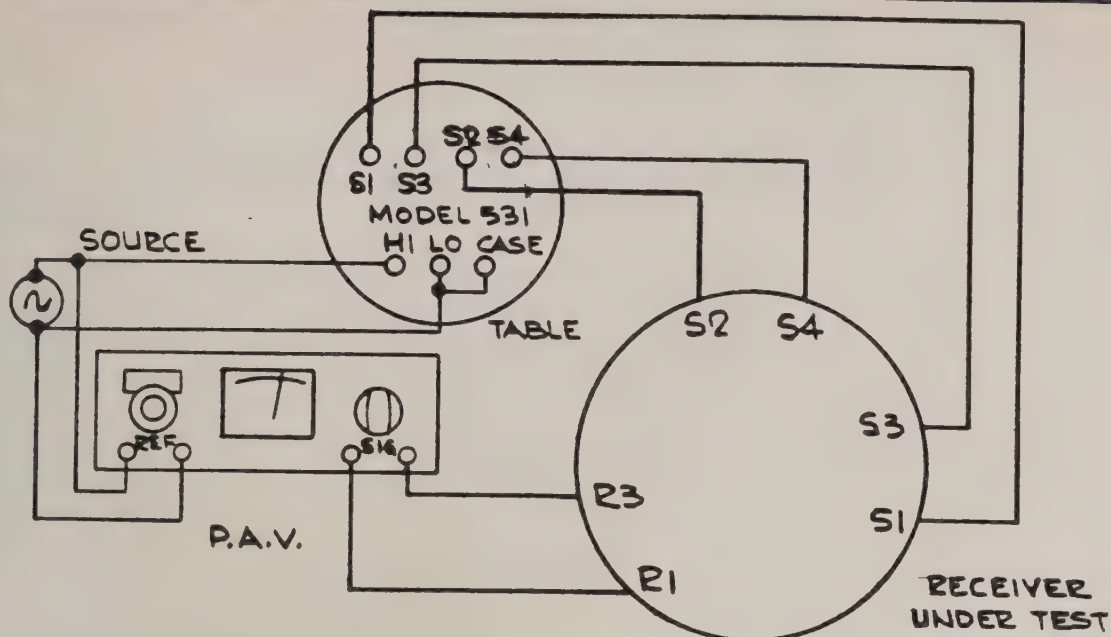
Angle Switches and Readout

The electrical angular setting of the Simulator is adjusted by means of two angle selector thumbwheel switches located on the front. The angle is read directly on the switch.

The first switch controls the most significant digit and advances the angle by 45° steps. The second switch controls the 5° increments from 0° to 40°.

Applications

There are many methods in which a Simulator can be used as a test instrument for the evaluation, calibration, and alignment of resolver and synchro components. The following examples are meant to serve as a guide only. Many other applications in such areas as control circuit, phase shifters, etc., will no doubt occur to the user once familiar with the instruments capability.



TYPICAL TEST HOOK-UP FOR TESTING A RESOLVER CIRCUIT - FIG. 3

Adjusting a Receiver or System to a Predetermined Angle

With the Simulator connected to provide an input to the receiver under test, set the Angle Selector Knobs so as to adjust the Simulator to the desired angle. Then adjust the receiving resolver or synchro to obtain a null on the output of the receiver as evidenced either by an external Phase Angle Voltmeter (See Figure 3) or by some pre-established output of the system being aligned. For example, if a servo such as a North Atlantic API-8025 were being tested, the counter readout would be used to indicate the null position of the receiver shaft.

At this point, increasing the Simulator angle will cause a positive change in resolver or synchro data and in the case of a system under test will cause the system output to increase providing the system or components are wired in accordance with the conventions of Section IV. If an opposite deflection occurs, the receiver being aligned is 180° in error and should be repositioned by this amount.

Note that in systems incorporating resolvers and synchros the conventions of Section IV are frequently altered to provide fixed offset angles or to reverse direction of rotation. The user must, therefore, verify the nature of the system's performance requirements before interpreting the results of the foregoing test.



Using the Phase Angle Voltmeter for Measuring Receiver Angle Error

This method is frequently used in testing synchro or resolver receivers where the inputs are in the form of discrete shaft angle increments. Typically, a component under test would be mounted in a device such as a dividing head. The simulator and dividing head would be set to 0° and the component positioned to 0° angle in the manner described in the previous paragraphs or by the electrical zero method of the applicable military specifications. Both the simulator and the dividing head are then advanced in the desired increments. The amplitude of the null voltage as measured on the output of the receiving component is related to the error angle as follows:

$$E_{out} = K \sin (\theta - \phi)$$

$$\sim = K (\theta - \phi)$$

Where K is gradient of device under test ($\theta - \phi$)
is error angle component

Since this relationship holds for small deviations at all angular settings whether the component is a resolver or synchro the null meter can easily be used to read a voltage which is proportioned to degrees, minutes, or seconds of arc.

As a matter of added convenience, a Phase Angle Voltmeter having a variable range attenuator will permit the user to scale the null meter sensitivity such that the error angle can be read directly in degrees, minutes, or seconds from the meter itself.



SECTION IV

CONVENTIONS

Conventions for polarities, terminal designation, and direction of shaft rotation for synchros and resolvers are most frequency defined in accordance with military specifications MIL-S-20708A (synchros) and MIL-R-21530 (resolvers).

North Atlantic Bridges and Simulators all have terminal designations and electrical characteristics consistent with these same specifications. Thus, a Bridge is used as though it were a receiving component such as a control transformer (CT or RC). Likewise, a Simulator is comparable to a transmitting component (CX or RX).

In applying the conventions, caution must be exercised that:

1. The manufacturer of the synchro or resolver followed the mil-spec conventions.
2. System use of the component has not dictated a change in convention in order to achieve a difference in characteristic such as direction reversal or mechanical shaft offset.

Resolver Conventions

Resolver Transmitter (RX), Control Transformer (RC), and Differential Resolver (RD)

The equation describing an ideal resolver apply as well to all Series 540 and 541 Bridges and 530 and 531 Simulators. They are:



For Rotor Energized Resolvers:

$$\begin{matrix} E & = & NE & \cos \theta - NE & \sin \theta \\ (S1-S3) & & (R1-R3) & & (R2-R4) \end{matrix}$$

$$\begin{matrix} E & = & NE & \cos \theta + NE & \sin \theta \\ (S2-S4) & & (R2-R4) & & (R1-R3) \end{matrix}$$

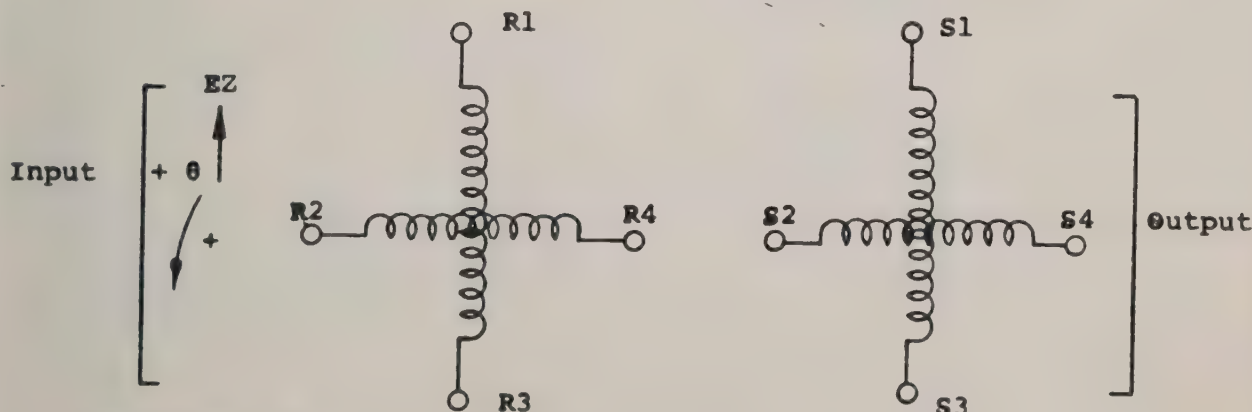
For Stator Energized Resolvers:

$$\begin{matrix} E & = & NE & \cos \theta + NE & \sin \theta \\ (R1-R3) & & (S1-S3) & & (S2-S4) \end{matrix}$$

$$\begin{matrix} E & = & NE & \cos \theta - NE & \sin \theta \\ (R2-R4) & & (S2-S4) & & (S1-S3) \end{matrix}$$

Where: Symbols have meaning defined above.

The schematic representation for a Resolver Transmitter (RX), Resolver Control Transformer (RC), or a Differential Resolver (RD) with the rotor excited is shown below in Figure 4.5. Input and output can be reversed for stator excited schematic.



(+θ is ccw as
viewed from
mounted end)

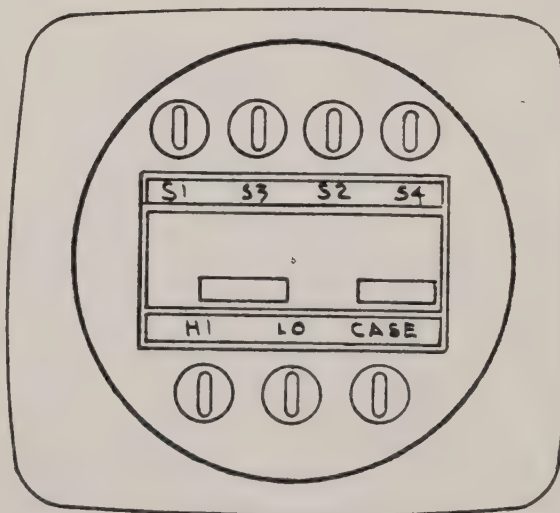
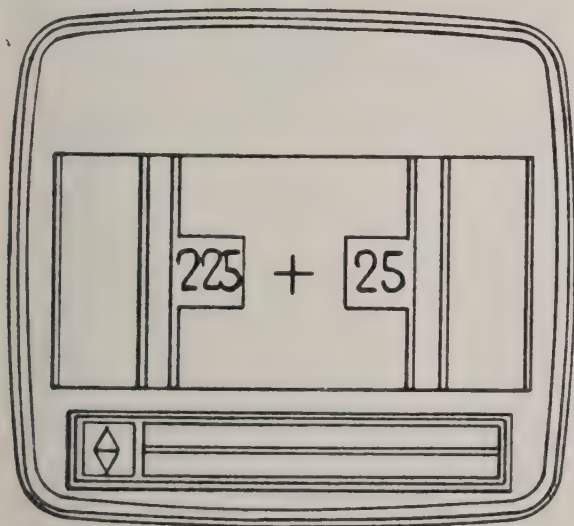
Figure 4.5 - Rotor Excited Resolver at
EZ, RX, or RD



NOTE: Resolver is shown at $\theta = EZ$ (electrical zero). This is defined as a minimum coupling from (R1-R3) to (S2-S4) for rotor excited case. For stator excited resolver EZ is defined for minimum coupling from (S1-S3) to (R2-R4).

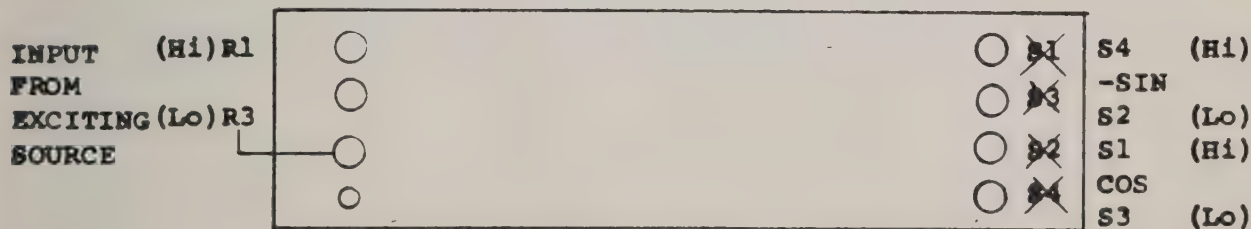
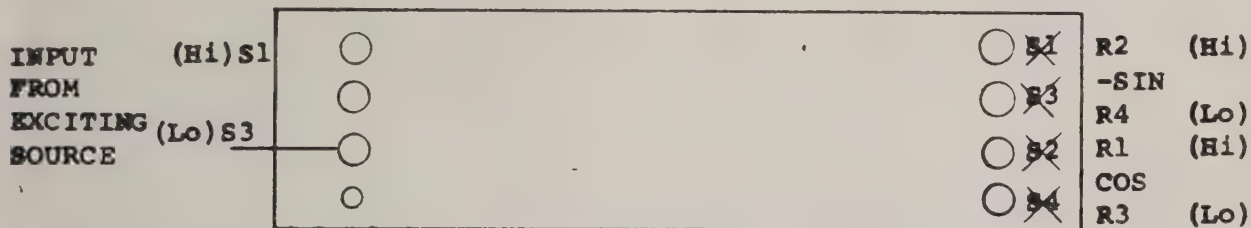
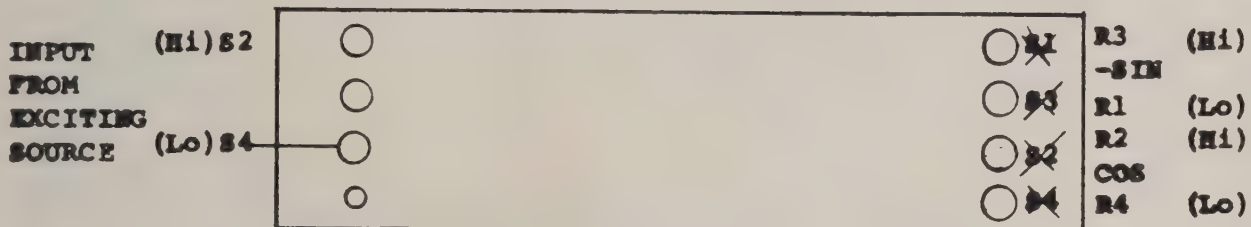
Resolver Simulator

The input and output terminals of a North Atlantic Series 530, 531 Resolver Simulator are analogous to those of a rotor excited Resolver Transmitter (RX). The connections which correspond to those shown in the diagram of 4.5 are illustrated below in Figure 4.6 for a Model 530 Simulator in the Resolver Mode.





ALTERNATE RESOLVER SIMULATOR CONVENTIONS
(ALL ASSUME CCW IS POSITIVE ROTATION)



MODEL 530 SIMULATOR
RESOLVER MODE

FIGURE 4.6



SECTION V

MAINTENANCE

The North Atlantic Series 530 Resolver-Synchro Simulators contain highly accurate inductive circuits. Under normal operating conditions, the accuracy of these devices should remain within the specified tolerances indefinitely. It should be noted, however, that the application of DC to the circuits used in the 530 could result in a degradation of the operating characteristics.

Degaussing

If DC has been applied to any of the terminals in the 530, the instrument may be degaussed by attaching the circuit shown in 5.1 to all input terminal pairs in sequence. For dual-mode degaussing, the three synchro inputs will cover both modes.

With all knobs set at zero, apply the 60Hz voltage to the instrument by slowly raising from zero until the point at which saturation occurs.

This will be evidenced when further increasing the setting of the Variac results in a relatively small increase in the voltage applied across the instrument. Allow the instrument to remain under the saturated conditions for a short period (typically 5 to 10 minutes). Then, slowly, over about the same period, reduce the voltage to the instrument to zero. Any residual magnetism which had been stored in the core by the DC should now be removed and the instrument should function properly. If the instrument still does not function with the specified tolerance, it should be returned to the factory.

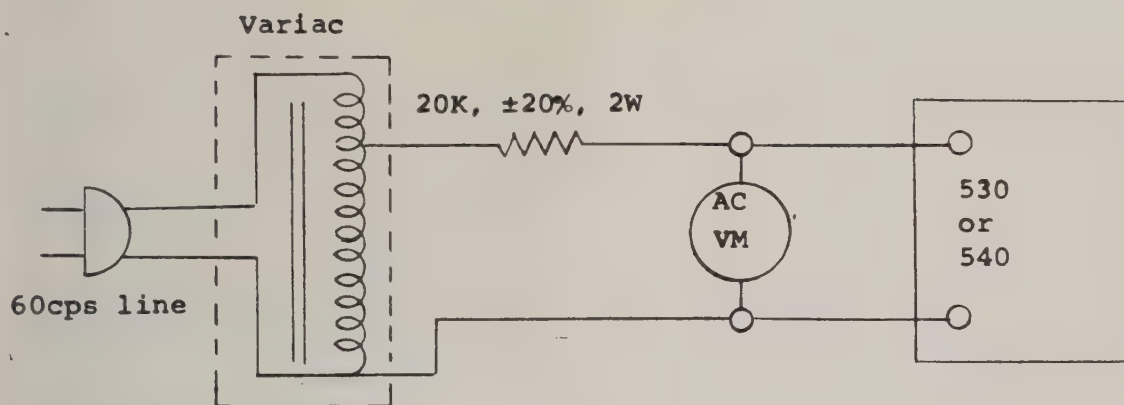


FIGURE 5.1

DEGAUSSING CIRCUIT



SWITCHES

All switches used are sealed drip-proofed thumbwheel types, designed for long-life using heavy duty silver alloy contacts.

The switches are factory lubricated during assembly, and due to the sealed nature of the design, need not be relubricated within the life of the instrument.

Should a precision switch need to be replaced, remove all wire connections by carefully unsoldering the wire and disassembling the bezel assembly.

TRANSFORMERS

If a malfunction occurs which indicates that a transformer component is faulty, return the unit to the factory for overhaul and recalibration.

CALIBRATION

Routine recalibration of the North Atlantic Industries' Simulator normally is not required. If, however, these checks are necessary to be sure that no random failures have caused the instrument to malfunction, a North Atlantic Model 540-S743 Resolver/Synchro Bridge and a Model 212 or 214 Phase Angle Voltmeter, or their equivalents, should be used.



SECTION VI

REPLACEMENT PARTS LIST



REPLACEMENT PARTS LIST

<u>DESIGNATION</u>	<u>DESCRIPTION</u>	<u>NAI PART NO.</u>	<u>TOTAL QTY.</u>
	Resolver Simulator	405301	
S1 - A & B	Switch Module	412296	
S1 - C & D	Switch Module	412297	
S2 - A & B	Switch Module	412298	
S2 - C & D	Switch Module	412299	
	Transformer Assembly	500825	
	Pin	203971	

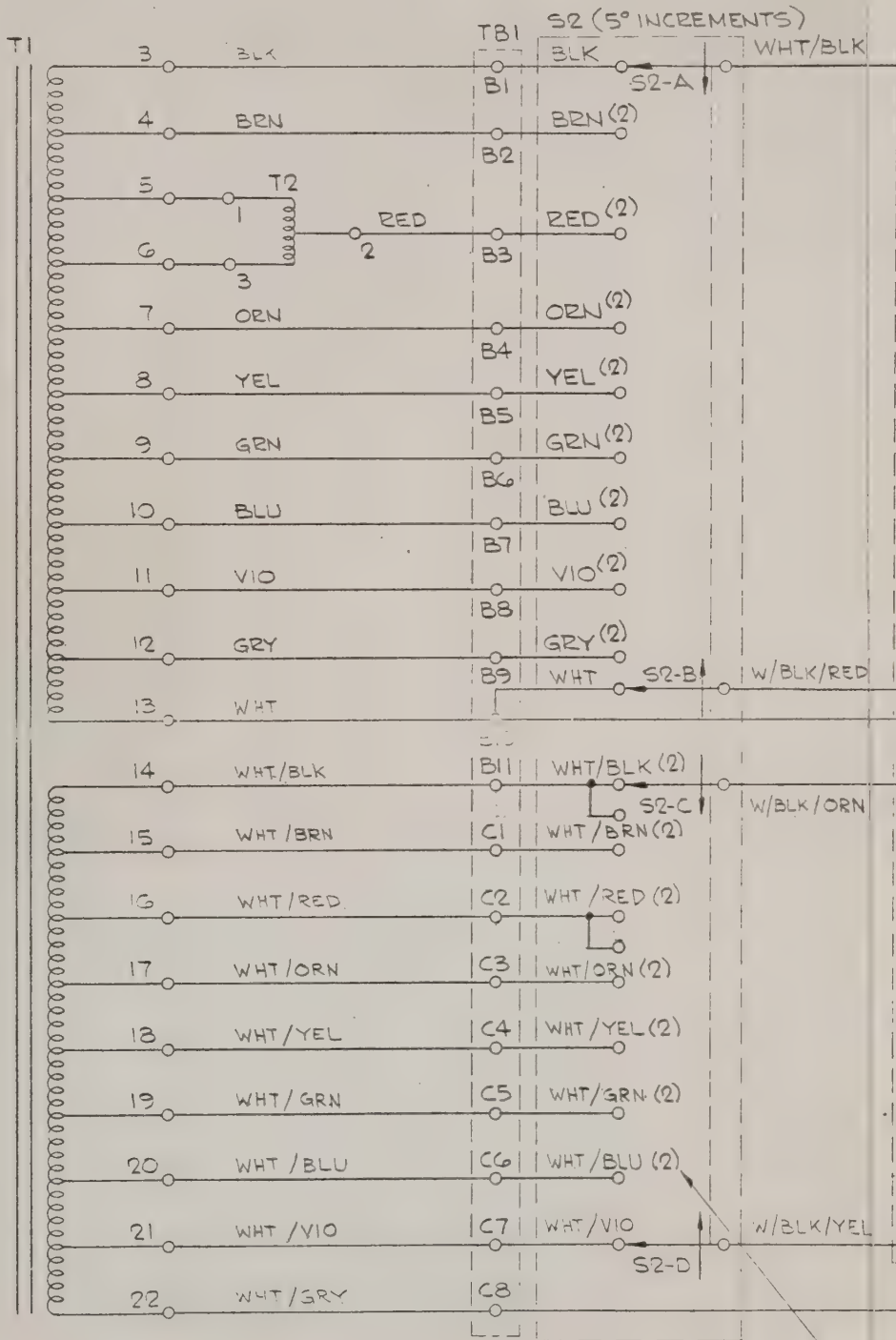
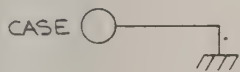
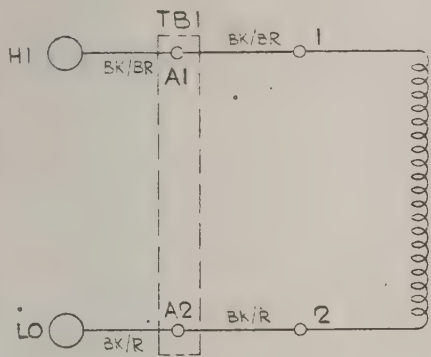
Consistent with North Atlantic Industries' policy of continuously up-grading components and improving circuits, we reserve the right to substitute components which are functionally interchangeable for any of the parts shown above.

6.1

NORTH ATLANTIC industries, inc.

200 terminal drive, plainview, n. y.

Overbrook 1-8800

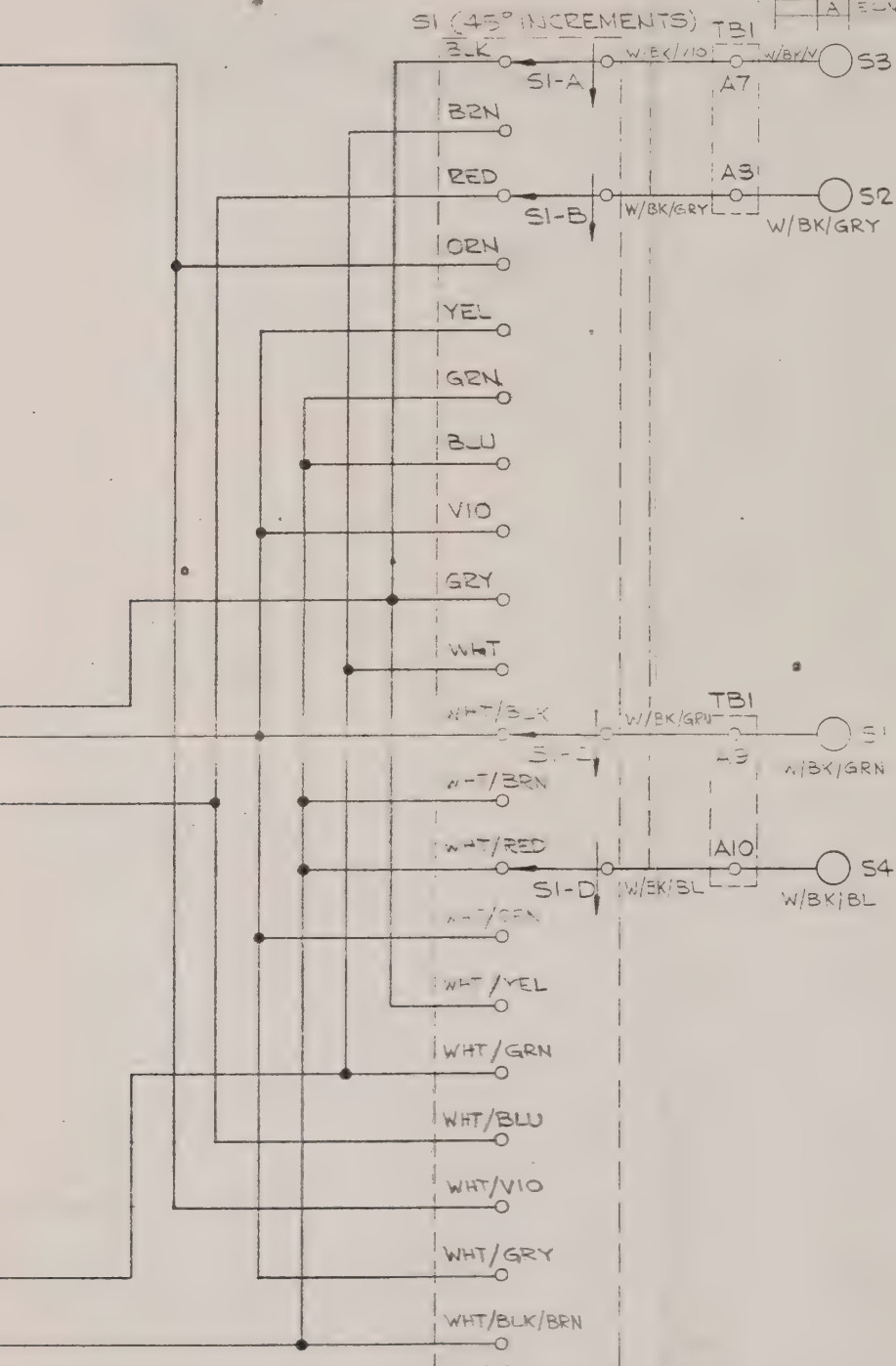


NOTE:

1-WIPERS ARE SHOWN IN POSITION
ARROWS SHOWING ROTATION FOR
ANGLE.

THE WIPERS OF THE WIRE ARE
MAKE THE CONNECTION.

REVISIONS		DATE	APPROV
ZONE	LT	DESCRIPTION	
A	1	REVISED	1-6-77



NOTE 2

WITH INCREASING

RESOLUTION

QTY REQD	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE	ITEM NO
LIST OF MATERIALS OR PARTS LIST					
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES (RANGER ON)		CONTRACT NO	NORTH ATLANTIC INDUSTRIES, INC. PLAINVIEW, NEW YORK		
DRAWN L. HAMER		DATE 3-2-77	SCHEMATIC, RESOLVER		
			MODEL 531		
APPLICATION		SCALE 1" = 1"			



WARRANTY

- A. The Seller warrants Products against defects in material and workmanship for one year from the date of original shipment. The Seller's liability is limited to the repair or replacement of Products which prove to be defective during the Warranty period. There is no charge under the Warranty except for transportation charges. The Purchaser shall be responsible for Products shipped until received by the Seller.
- B. The Seller specifically excludes from the Warranty 1) calibration, 2) fuses, and 3) normal mechanical wear, eg, end-of-life on assemblies such as switches, relays, gear trains, etc. is dependent upon number of operations or hours of use, and end-of-life may occur within the Warranty period.
- C. The Seller is not liable for consequential damages or for any injury or damage to persons or property resulting from the operation or application of Products.
- D. The Warranty is voided if there is evidence that Products have been operated beyond their design range, improperly installed, improperly maintained or physically mistreated.
- E. The Seller reserves the right to make changes and improvements to Products without any liability for incorporating such changes or improvements in any Products previously sold, or for any notification to the Purchaser prior to shipment. In the event the Purchaser should require subsequently manufactured lots to be identical to those covered by this Quotation, the Seller will, upon written request, provide a quotation upon a change control program.
- F. No other Warranty expressed or implied is offered by the Seller other than the foregoing.



CLAIMS FOR DAMAGE IN SHIPMENT

The purchaser should inspect and functionally test the Product(s) in accordance with the instruction manual as soon as it is received. If the product is damaged in any way, including concealed damage, a claim should be filed immediately with the carrier, or, if insured separately, with the purchaser's insurance company.

SHIPPING

On products to be returned under warranty, await receipt of shipping instructions, then forward the instrument prepaid to the destination indicated. The original shipping containers with their appropriate blocking and isolating material is the preferred method of packaging. Any other suitably strong container may be used providing the product is wrapped in heavy paper or a plastic bag and surrounded with at least four inches of shock absorbing material to cushion firmly, preventing movement inside the container.

WARRANTY REGISTRATION

Please complete and mail this Warranty Registration Card without delay. Placing this Registration on file with our Service Department will assure that you receive applicable service data as issued. No postage is required. (Mailed on _____ by _____)

SERVICE INFORMATION

This card is provided to aid you in obtaining prompt assistance with questions you may have regarding operation, calibration, maintenance or service parts for your North Atlantic instrument. State information desired and mail. No postage is required.

SERVICE INFORMATION

This card is provided to aid you in obtaining prompt assistance with questions you may have regarding operation, calibration, maintenance or service parts for your North Atlantic instrument. State information desired and mail. No postage is required.

WARRANTY REGISTRATION

Please register _____ Date _____
Model No. _____ Serial No. _____
under the terms of the warranty stated in this Instruction Manual.
Name _____
Title _____ Dept. _____
Company _____
Address _____
City _____ State _____ ZIP _____
Calibration and maintenance responsibility has been assigned to the following person and/or department. Address applicable service data to (if same as above, please state):
Name _____
Title _____ Dept. _____
For our information please indicate:
Condition of instrument on receipt _____
Application _____
Will the instrument be: resold as part of a system? _____
maintained as company equipment? _____

SERVICE INFORMATION REQUEST

Instrument _____
Model No. _____ Serial No. _____
We require the following service information: _____

Name _____ Title _____
Company _____ Dept. _____
Address _____
City _____ State _____ ZIP _____
Phone _____ Ext. _____

SERVICE INFORMATION REQUEST

Instrument _____
Model No. _____ Serial No. _____
We require the following service information: _____

Name _____ Title _____
Company _____ Dept. _____
Address _____
City _____ State _____ ZIP _____
Phone _____ Ext. _____

(please send additional Service Information Request cards _____)

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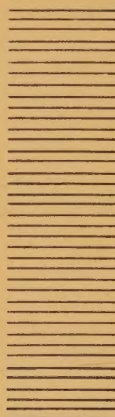
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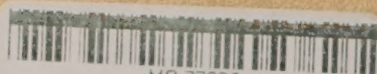
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